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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/694,684	10/28/2003	Ping-Yi Hsin	TS02-1193	3911
8933	7590	06/01/2005	EXAMINER	
DUANE MORRIS, LLP IP DEPARTMENT ONE LIBERTY PLACE PHILADELPHIA, PA 19103-7396			GARCIA, JOANNIE A	
			ART UNIT	PAPER NUMBER
			2823	

DATE MAILED: 06/01/2005

Please find below and/or attached an Office communication concerning this application or proceeding.

SM

Office Action Summary	Application No. 10/694,684	Applicant(s) HSIN ET AL.	
	Examiner Joannie A. Garcia	Art Unit 2823	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 15 March 2005.
- 2a) ☐ This action is FINAL. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-31 is/are pending in the application.
- 4a) Of the above claim(s) 22-30 is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 1-21 and 31 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☒ The drawing(s) filed on 28 October 2003 is/are: a) ☐ accepted or b) ☒ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some * c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. _____.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- | | |
|---|---|
| 1) <input checked="" type="checkbox"/> Notice of References Cited (PTO-892) | 4) <input type="checkbox"/> Interview Summary (PTO-413)
Paper No(s)/Mail Date. _____ |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948) | 5) <input type="checkbox"/> Notice of Informal Patent Application (PTO-152) |
| 3) <input checked="" type="checkbox"/> Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08)
Paper No(s)/Mail Date <u>01-29-04</u> . | 6) <input type="checkbox"/> Other: _____ |

Applicant's election with traverse of Group II, claims 1-21, in the reply filed on 03-11-05 is acknowledged. The traversal is on the ground(s) that the searches are the same, and because of issues related to compact prosecution and public interest. This is not found persuasive because valid reasons for restriction have been stated and applicant does not address these reasons for restriction.

The requirement is still deemed proper and is therefore made FINAL.

Claims 2-8, 10, 12-21, and 31, are objected to because of the following informalities:

In claim 2, line 7, "comprises" before "forming initial via", should be replaced with --comprising--.

In claim 8, line 2, "a" before "etch stop layer", first occurrence, should be replaced with -an--.

In claim 12, line 6, "silicon oxide" should be preceded by --such as--.

Claim 12 recites the limitation "remaining top layer" in line 15. There is insufficient antecedent basis for this limitation in the claim.

Claim 12 recites the limitation "lower portions of the respective opposing initial via openings" in line 19. There is insufficient antecedent basis for this limitation in the claim.

Claim 12 recites the limitation "underlying metal structure" in line 20. There is insufficient antecedent basis for this limitation in the claim.

In claims 17-19, line 1, "a" before "etch stop layer" should be replaced with --an--.

Claim 31 recites the limitation "structure" in line 1. There is insufficient antecedent basis for this limitation in the claim.

Appropriate correction is required.

The drawings are objected to as failing to comply with 37 CFR 1.84(p)(5) because they include the following reference character(s) not mentioned in the description: 50. Corrected drawing sheets in compliance with 37 CFR 1.121(d), or amendment to the specification to add the reference character(s) in the description in compliance with 37 CFR 1.121(b) are required in reply to the Office action to avoid abandonment of the application. Any amended replacement drawing sheet should include all of the figures appearing on the immediate prior version of the sheet, even if only one figure is being amended. Each drawing sheet submitted after the filing date of an application must be labeled in the top margin as either "Replacement Sheet" or "New Sheet" pursuant to 37 CFR 1.121(d). If the changes are not accepted by the examiner, the applicant will be notified and informed of any required corrective action in the next Office action. The objection to the drawings will not be held in abeyance.

The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(e) the invention was described in (1) an application for patent, published under section 122(b), by another filed in the United States before the invention by the applicant for patent or (2) a patent granted on an application for patent by another filed in the United States before the invention by the applicant for patent, except that an international application filed under the treaty defined in section 351(a) shall have the effects for purposes of this subsection of an application filed in the United States only if the international application designated the United States and was published under Article 21(2) of such treaty in the English language.

Claims 1, 2, 7, 10, 11, and 31, are rejected under 35 U.S.C. 102(e) as being anticipated by Kim (U.S. Patent 6,767,788).

Kim discloses forming a MIM capacitor comprising providing a structure comprising a silicon substrate 11 having an underlying copper metal structure 13 formed there over (Figure 1A, and Column 4, lines 34-37), forming a dielectric layer 17 with a constant of less than 3.0 such as silicon oxide or FSG over the substrate (Figure 1A, and Column 4, lines 48-51), forming an etch stop layer 14 between the metal structure and the dielectric layer (Figure 1A, and Column 4, lines 58-61), forming a top layer 18 over the dielectric layer having a thickness of 1000 angstroms (Figure 1A, and Column 4, lines 58-61), forming a capacitance trench through the top layer and into the dielectric layer formed over the silicon substrate, the capacitance trench having opposing side walls and a bottom (Figure 1B, Column 3, lines 62-65, and Column 5, lines 10-20), forming a silicon nitride etch stop layer 16 between the metal structure and the dielectric layer, having a thickness of 400 angstroms (Figure 1A, Column 4, lines 58-64).

Kim discloses as well, forming respective TaN or TiN bottom electrodes 20/21 along the opposing side walls (Figure 1C, and Column 5, lines 28-53), forming an oxide capacitance dielectric layer 22 along the respective bottom electrodes, the bottom of the capacitance trench, and a remaining top layer (Figure 1C, and Column 5, lines 47-58), forming respective opposing initial via openings adjacent the capacitance trench exposing portions of the metal structure (Figure 1B, and 1D), forming respective trench openings 19/24 above, continuous, and contiguous with lower portions of the respective opposing initial via openings, and exposing portions of the underlying copper metal structure to form respective dual damascene openings (Figures 1B, and 1D, Column 5, lines 1-5, and Column 6, lines 1-5), forming copper planarized metal portions within the dual damascene openings (Figures 1E-1F), and the capacitance trench

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to form a top electrode 23/25/26 to complete formation of the MIM capacitor (Figure 1E, and 1F, and Column 6, lines 36-55).

Claims 3-6, 8, and 9, are rejected under 35 U.S.C. 103(a) as being unpatentable over Kim as applied to claims 1, 2, 7, 10, 11, and 31, above, and further in view of Wang et al (U.S. Patent 6,589,862), and the following comments.

Kim discloses forming an etch stop layer 14 made of silicon nitride or silicon carbide between the metal structure and the dielectric layer having a thickness of about 100-1000 angstroms (Figure 1A, and Column 4, lines 58-61). Kim does not teach forming the etch stop layer 14 having a thickness of about 300 to 900 angstroms, or of about 400 to 600 angstroms. Kim discloses overlapping between the recited ranges and the disclosed ranges (See MPEP 2144.05).

Kim discloses in a dual damascene process, using as an etch stop layer to pattern vias and trenches, top layer 16 using a SiN, SiC, or a SiCN material (Figure 1A, and Column 4, lines 58-64). Kim does not teach forming the top layer using silicon oxynitride material. Wang et al discloses in a dual damascene process, using as an etch stop layer, a top layer using a SiO₂, SiN, or a SiON material (Column 2, lines 15-21). It would have been within the scope of one of ordinary skill in the art to combine the teachings of Kim and Wang et al, to enable the top layer 16 formation step of Kim to be performed by employing any of the disclosed materials of Wang et al, such as a SiO₂, SiN, or a SiON material.

Kim discloses the claimed invention except for the metal structure to have a thickness of 1000 to 9000 angstroms, or 2000 to 8000 angstroms; the dielectric layer to have a thickness of

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2000 to 12,222 angstroms, or 7000 to 9000 angstroms; the bottom electrodes to have a thickness of 100 to 500 angstroms, or 200 to 400 angstroms; and the capacitance dielectric layer to have a thickness of 100 to about 600 angstroms, or 250 to 350 angstroms. It would have been obvious to one having ordinary skill in the art at the time the invention was made to determine a suitable thickness for the metal structure, the dielectric layer, the bottom electrodes, and the capacitance dielectric layer, since it has been held that where the general conditions of a claim are disclosed in the prior art, discovering the optimum or workable ranges involves only routine skill in the art. *In re Aller*, 105 USPQ 233.

In addition, the selection of a suitable thickness for the metal structure, the dielectric layer, the bottom electrodes, and the capacitance dielectric layer, it's obvious because it is a matter of determining optimum process conditions by routine experimentation with a limited number of species of result effective variables. These claims are prima facie obvious without showing that the claimed ranges achieve unexpected results relative to the prior art range. *In re Woodruff*, 16 USPQ2d 1935, 1937 (Fed. Cir. 1990). See also *In re Huang*, 40 USPQ2d 1685, 1688 (Fed. Cir. 1996)(claimed ranges or a result effective variable, which do not overlap the prior art ranges, are unpatentable unless they produce a new and unexpected result which is different in kind and not merely in degree from the results of the prior art). See also *In re Boesch*, 205 USPQ 215 (CCPA) (discovery of optimum value of result effective variable in known process is ordinarily within skill or art) and *In re Aller*, 105 USPQ 233 (CCPA 1995) (selection of optimum ranges within prior art general conditions is obvious).

Note that the specification contains no disclosure of either the critical nature of the claimed thicknesses or any unexpected results arising therefrom. Where patentability is said to

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be based upon particular chosen thicknesses or upon another variable recited in a claim, the Applicant must show that the chosen thicknesses are critical. *In re Woodruf*, 919 F.2d 1575, 1578, 16 USPQ2d 1934, 1936 (Fed. Cir. 1990).

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

Claims 12-21 are rejected under 35 U.S.C. 103(a) as being unpatentable over Kim (U.S. Patent 6,767,788), in combination with Wang et al (U.S. Patent 6,589,862) and the following comments.

Kim discloses forming a MIM capacitor comprising providing a structure comprising a silicon substrate 11 having an underlying copper metal structure 13 formed there over (Figure 1A, and Column 4, lines 34-37), forming a dielectric layer 17 with a constant of less than 3.0 such as silicon oxide or FSG (Figure 1A, and Column 4, lines 48-51), forming an etch stop layer 14 made of silicon nitride or silicon carbide between the metal structure and the dielectric layer having a thickness of 300 to 400 angstroms (Figure 1A, and Column 4, lines 58-61), forming a top layer 18 over the dielectric layer having a thickness of 1000 angstroms (Figure 1A, and Column 4, lines 58-61), forming a capacitance trench through the top layer and into the dielectric layer formed over the silicon semiconductor substrate, the capacitance trench having opposing side walls and a bottom (Figure 1B, Column 3, lines 62-65, and Column 5, lines 10-20), forming

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a silicon nitride etch stop layer 16 between the metal structure and the dielectric layer, having a thickness of 400 angstroms (Figure 1A, Column 4, lines 58-64).

Kim discloses as well, forming respective TaN or TiN bottom electrodes 20/21 along the opposing side walls (Figure 1C, and Column 5, lines 28-53), forming an oxide capacitance dielectric layer 22 along the respective bottom electrodes, the bottom of the capacitance trench, and a remaining top layer (Figure 1C, and Column 5, lines 47-58), forming respective opposing initial via openings adjacent the capacitance trench exposing portions of the metal structure (Figure 1B, and 1D), forming respective trench openings 19/24 above, continuous, and contiguous with lower portions of the respective opposing initial via openings, and exposing portions of the underlying copper metal structure to form respective dual damascene openings (Figures 1B, and 1D, Column 5, lines 1-5, and Column 6, lines 1-5), forming copper planarized metal portions within the dual damascene openings (Figures 1E-1F), and the capacitance trench to form a top electrode 23/25/26 to complete formation of the MIM capacitor (Figure 1E, and 1F, and Column 6, lines 36-55).

Kim discloses forming an etch stop layer 14 made of silicon nitride or silicon carbide between the metal structure and the dielectric layer having a thickness of about 100-1000 angstroms (Figure 1A, and Column 4, lines 58-61). Kim does not teach forming the etch stop layer 14 having a thickness of about 300 to 900 angstroms, or of about 400 to 600 angstroms. Kim discloses overlapping between the recited ranges and the disclosed ranges (See MPEP 2144.05).

Kim discloses in a dual damascene process, using as an etch stop layer to pattern vias and trenches, top layer 16 using a SiN, SiC, or a SiCN material (Figure 1A, and Column 4, lines 58-

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64). Kim does not teach forming the top layer using silicon oxynitride material. Wang et al discloses in a dual damascene process, using as an etch stop layer, a top layer using a SiO₂, SiN, or a SiON material (Column 2, lines 15-21). It would have been within the scope of one of ordinary skill in the art to combine the teachings of Kim and Wang et al, to enable the top layer 16 formation step of Kim to be performed by employing the any of the disclosed materials of Wang et al.

Kim discloses the claimed invention except for the metal structure to have a thickness of 1000 to 9000 angstroms, or 2000 to 8000 angstroms; the dielectric layer to have a thickness of 2000 to 12,222 angstroms, or 7000 to 9000 angstroms; the bottom electrodes to have a thickness of 100 to 500 angstroms, or 200 to 400 angstroms; and the capacitance dielectric layer to have a thickness of 100 to about 600 angstroms, or 250 to 350 angstroms. It would have been obvious to one having ordinary skill in the art at the time the invention was made to determine a suitable thickness for the metal structure, the dielectric layer, the bottom electrodes, and the capacitance dielectric layer, since it has been held that where the general conditions of a claim are disclosed in the prior art, discovering the optimum or workable ranges involves only routine skill in the art. *In re Aller*, 105 USPQ 233.

In addition, the selection of a suitable thickness for the metal structure, the dielectric layer, the bottom electrodes, and the capacitance dielectric layer, it's obvious because it is a matter of determining optimum process conditions by routine experimentation with a limited number of species of result effective variables. These claims are prima facie obvious without showing that the claimed ranges achieve unexpected results relative to the prior art range. In re Woodruff, 16 USPQ2d 1935, 1937 (Fed. Cir. 1990). See also In re Huang, 40 USPQ2d 1685,

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1688 (Fed. Cir. 1996)(claimed ranges or a result effective variable, which do not overlap the prior art ranges, are unpatentable unless they produce a new and unexpected result which is different in kind and not merely in degree from the results of the prior art). See also *In re Boesch*, 205 USPQ 215 (CCPA) (discovery of optimum value of result effective variable in known process is ordinarily within skill or art) and *In re Aller*, 105 USPQ 233 (CCPA 1995) (selection of optimum ranges within prior art general conditions is obvious).

Note that the specification contains no disclosure of either the critical nature of the claimed thicknesses or any unexpected results arising therefrom. Where patentability is said to be based upon particular chosen thicknesses or upon another variable recited in a claim, the Applicant must show that the chosen thicknesses are critical. *In re Woodruff*, 919 F.2d 1575, 1578, 16 USPQ2d 1934, 1936 (Fed. Cir. 1990).

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Joannie García whose telephone number is (571) 272-1861. The examiner can normally be reached on Monday through Friday.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Olik Chaudhuri, can be reached on (571) 272-1855. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications

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may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).



George Fourson
Primary Examiner
Art Unit 2823



JAG

May 25, 2005

GFourson
Primary Examiner